REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
03-22-2011	Master of Military Studies Research Paper	September 2010 - April 2011

4. TITLE AND SUBTITLE
ASSAULT SUPPORT SURVIVABILITY: THE OPERATIONAL IMPACT ON MARINE CORPS ASSAULT SUPPORT HELICOPTER AND TILT-ROTOR OPERATIONS

5a. CONTRACT NUMBER
N/A

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

6. AUTHOR(S)
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5d. PROJECT NUMBER
N/A

5e. TASK NUMBER
N/A

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
USMC Command and Staff College
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2076 South Street
Quantico, VA 22134-5068

8. PERFORMING ORGANIZATION REPORT NUMBER
N/A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSOR/MONITOR'S ACRONYM(S)
N/A

11. SPONSORING/MONITORING AGENCY REPORT NUMBER
N/A

12. DISTRIBUTION AVAILABILITY STATEMENT
Unlimited

13. SUPPLEMENTARY NOTES
N/A

14. ABSTRACT
The ability of Marine Corps' Air Combat Element to conduct Assault Support Operations is lacking in key mechanisms. Survivability considerations must be considered in training of aircrews, equipping and design of airframes and how doctrine is applied. Training of aircrews to understand the importance of survivability is essential. Training and Readiness Manuals must incorporate susceptibility and vulnerability considerations into every mission set. Survivability in aircraft design and refit must be comprehensive and far reaching. Real time reaction to a threat is not the solution. Aircraft systems need to provide early, accurate, and networked threat information to ensure mission accomplishment. Marine Corps doctrine for the employment of Assault Support is not lacking. The doctrinal basis for the employment of Marine aviation in support of the Marine Corps' mission is not flawed. However, organizational prejudices and momentum create lapses in mission tempo and therefore prevent the ACE from providing its' full Assault Support capabilities.

15. SUBJECT TERMS
USMC ASSAULT SUPPORT SURVIVABILITY

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Marine Corps University / Command and Staff College
Unclass	Unclass	Unclass	UU	28	19b. TELEPONE NUMBER *(Include area code)* (703) 784-3330 (Admin Office)

United States Marine Corps
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MASTER OF MILITARY STUDIES

ASSAULT SUPPORT SURVIVABILITY: THE OPERATIONAL IMPACT ON MARINE CORPS ASSAULT SUPPORT HELICOPTER AND TILT-ROTOR OPERATIONS

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

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AY 10-11

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Approved: Richard L. DiNardo
Date: 22 March 2011

Oral Defense Committee Member:
Approved:
Date: 3-22-11

EXECUTIVE SUMMARY

Title: Assault Support Survivability: The Operational Impact on Marine Corps Helicopter and Tilt-Rotor Operations.

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Thesis: The ability of Marine Corps' Air Combat Element to conduct Assault Support Operations is lacking in key mechanisms. Survivability considerations must be considered in training of aircrews, equipping and design of airframes and how doctrine is applied.

Discussion: This paper will address the current training, equipping, and fighting of Marine Corps helicopters and tilt rotor aircraft for combat survivability. It will examine the Marine Corps ability to successfully train, equip and fight these assets on a conventional and non-convention battlefield and weigh the concerns of survivability and mission accomplishment.

Conclusion: Training of aircrews to understand the importance of survivability is essential. Training and Readiness Manuals must incorporate susceptibility and vulnerability considerations into every mission set. Survivability in aircraft design and refit must be comprehensive and far reaching. Real time reaction to a threat is not the solution. Aircraft systems need to provide early, accurate, and networked threat information to ensure mission accomplishment. Marine Corps doctrine for the employment of Assault Support is not lacking. The doctrinal basis for the employment of Marine aviation in support of the Marine Corps' mission is not flawed. However, organizational prejudices and momentum create lapses in mission tempo and therefore prevent the ACE from providing its' full Assault Support capabilities.

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TABLE OF CONTENTS

Page

PREFACE

The concept of survivability has been an interest of mine ever since my introduction to Marine tactical helicopter aviation. The ability to proceed into a hostile environment in a slow aircraft at low altitude with limited ability to detect and defeat air defense systems is perplexing. It has been successfully accomplished and is happening every day in Afghanistan and other hostile regions around the world. However, there have also been many failures.

The Soviets in Afghanistan suffered massive losses at the hands of an "inferior" enemy with limited air defense capabilities. The US reaped similar results in Iraq. The ability to employ helicopters on today's battlefields encompasses a great deal of risk. In saying helicopters, I include the MV-22 Osprey even though it is categorized as a tilt-rotor aircraft. When the nacelles are tilted up and it is on short final to the zone.... it is a helicopter. In order to mitigate this risk and prevent the further loss of lives and aircraft there needs to be a greater emphasis on helicopter survivability. Having cutting-edge radios, navigation equipment, weapons, well trained crews trained and validated doctrine are only a portion of the equation. I would argue a small portion.

Supplies are useless unless they are delivered in the correct location and when needed. Close air support can only be used effectively when it gets to the objective area, is able to remain on station and return to base. A quick reaction force cannot reinforce the Ground Combat Element if the helicopters it is embarked on are destroyed en route to the objective area. The need to refocus and find a balanced approach to helicopter survivability, specifically Marine Assault Support, training, equipment and doctrine is now.

I would like acknowledge the assistance I have received. First, I would like to thank Dr. Richard DiNardo for his mentorship and reality checks throughout this endeavor. Also the

mentorship and guidance I received from Colonel Thomas "Wheels" Weidley has been invaluable in my assessment and development as an attack helicopter pilot. I would like to thank Colonel Julian D. Alford for reminding me why it is I fly in support of the Marine on the ground and the honor and responsibility that comes with that charge. Finally, I must acknowledge the patience and support of my wife Clover and daughters Lily and Lola, who "allowed" me the time to complete this effort.

"Marine Aviation cannot allow our past accomplishments to formulate complacency or disregard for our existing or potential enemies."

-BGen M. Post, Assistant Deputy Commandant for Aviation before the Tactical Air& Land Forces Subcommittee and Readiness Subcommittee of the House Armed Services Committee on Rotor Craft Safety OIF & OEF, Feb 1, 2006

INTRODUCTION

This paper will address the current training, equipping, and fighting of Marine Corps' helicopters and tilt rotor aircraft for combat survivability. It will examine the Marine Corps' ability to successfully train, equip and fight these assets on the battlefield and weigh the concerns of survivability and mission accomplishment. The Marine Corps currently deploys as a Marine Air Ground Task Force (MAGTF) that incorporates the three primary functional areas of the service to create a composite force to employ the single battle concept: the Ground Combat Element (GCE), the Air Combat Element (ACE) and the Logistics Combat Element (LCE). This paper will focus on the ACE, specifically helicopter and tilt-rotor aircraft. Throughout the text the term helicopter will include tilt-rotor unless specified.

An analysis of training will examine the methods, standards, and assessment metrics of the Training and Readiness (T&R) Manuals as they apply to survivability. How the aircraft are currently configured and equipped will be considered against what upgrades are required for survivability. Lastly it will examine current Marine Corps doctrine and employment practices based on commanders' perspectives as well as future vision statements to understand how these aircraft are to be employed to support the GCE and LCE. To better illustrate the subject, brief case studies on helicopters in combat will be examined: first the Soviet invasion of Afghanistan 1981-1989, and then the United States experience in Operation IRAQI FREEDOM (OIF) 2003-2009. These vignettes will be framed in the context of training, equipping and fighting helicopters and the evolution of these themes from conventional to non-conventional warfare.

In order to better understand this analysis it is important to have a common lexicon. Combat survivability can be achieved in two ways. The first is to avoid being detected and avoid being hit by the enemy's weapons. This is known as susceptibility.[1] Susceptibility includes the location, number and capability of the enemies air defenses; the aircrafts basic design to include low infrared/radar signature, speed and agility; self-defense weapons and survivability equipment; and aircraft tactics, technics and procedures (TTPs) that are employed.[2] The second facet of survivability is vulnerability. Vulnerability is the inability of an aircraft to withstand a hit and continue to fly and fight.[3] Vulnerability includes the size, type, and number of the enemy's weapons that hit the aircraft; the aircraft's basic design (i.e. location of fuel tanks, redundant hydraulics, single or dual engine); and the survivability equipment installed to reduce the amount of damage (i.e. armor and self-sealing fuel tanks).[4]

There are several literary and doctrinal definitions for conventional and unconventional warfare. For the purposes of this analysis the following definitions and sources will be used:

> ***Conventional Warfare:*** *A form of warfare between states that employs direct military confrontation to defeat an adversary's armed forces, destroy an adversary's war-making capacity, or seize or retain territory in order to force a change in an adversary's government or policies. The focus of conventional military operations is normally an adversary's armed forces with the objective of influencing the adversary's government. It generally assumes that the indigenous populations within the operational area are non-belligerents and will accept whatever political outcome the belligerent governments impose, arbitrate, or negotiate. A fundamental military objective in conventional military operations is to minimize civilian interference in those operations.*[5]

> ***Unconventional Warfare:*** *A broad spectrum of military and paramilitary operations, normally of long duration, predominantly conducted through, with, or by indigenous or surrogate forces who are organized, trained, equipped, supported, and directed in varying degrees by an external source. It includes, but is not limited to, guerrilla warfare, subversion, sabotage, intelligence activities, and unconventional assisted recovery.*[6]

HELICOPTER SURVIVABILITY: TWO CASE STUDIES

The Soviet Union invasion of Afghanistan (1981-1989)

In late December of 1979 the Soviet 40th Army crossed into Afghanistan.[7] Their stated mission was "to render international aid to the friendly Afghan people and establish advantageous conditions to prevent possible actions by the governments of neighboring countries against Afghanistan."[8] The early years of conflict (1979-1981) were defined by conventional warfare. After suffering heavy losses against the Soviet Army, the opposition forces began resorting to unconventional warfare and moving into the mountains. This period also marked the rise of the Mujahedeen which would be the prevalent fighting force for the remaining Soviet occupation (1982-1989).[9]

Soviet Army Aviation had been preparing for operations in Afghanistan prior to the invasion training in mountain flying, basic weapons delivery missions, assault support and close air support training missions.[10] Helicopters conducted most missions at the minimum altitude permitted and operated using nap of the earth (NOE) techniques. The primary helicopters in country were the MIL Mi-24 HIND gunship, MIL Mi-8mt HIP armed transport, and the MIL Mi-6 HOOK heavy lift-transport.[11] These helicopters were armored and designed with vulnerability rather than susceptibility. Soviet pilots relied primarily on aircraft TTPs to enhance survivability.

Crews flew using NOE flight profiles in route and in the objective area. These missions were often accompanied by attached attack helicopter escort.[12] Soviet Army Aviation trained, equipped, and fought their helicopters well for conventional warfare. The Mi-24 HIND was feared by the Mujahedeen. Operating in flights of two or three the HINDs were devastatingly

effective in close air support, convoy and air escort, and armed reconnaissance missions. Air assault, Casualty Evacuation (Casevac) and logistic support from transport helicopters were essential in the mountains of Afghanistan.

In early 1981, the Mujahedeen began to evolve their anti-air TTPs. Helicopters were considered high value targets.[13] DShk heavy machine guns and RPG-7s were used in barrage fire in conjunction with small arms salvo fire to provide point air defense. These "ambush" tactics forced Soviet pilots to change their tactics and fly at higher altitudes to avoid damage. Helicopters began operating at 1500 to 2000 feet Above Ground Level (AGL). Flying at these altitudes effected weapons' accuracy, observation, and performance. Fewer helicopters were being lost, but operational effectiveness decreased.

Then in the mid 1980's, the introduction of the Soviet SA-7A Strella-2 and US Stinger man portable air defense systems (MANPADs) caused Soviet helicopter losses to spike. These infrared (IR) heat seeking missiles were able to effectively engage helicopters at 1500 to 2000 ft AGL. Soviet altitudes increased to 5000-7000 ft AGL. The next solution was to re-equip helicopters with IR reducing exhaust and install decoy expendables (flares) to defeat the missiles. These changes were slow and arduous and caused operational gaps in helicopter support. The combination of heavy machine gun ambushes at low altitudes and MANPAD ambushes at high altitudes forced Soviet commanders to drastically reduce the use of their helicopter daylight operations.[14]

Concurrently, Soviet Army aviation made changes in training. They incorporated new TTPs to deal with altitude. Night flight training and night vision devices (NVDs) were incorporated into flight training. Exhaust suppressors and expendables (flares or chaff) were

added to defeat MANPADs and night targeting sights were incorporated into fire control systems. These changes drove an evolution in TTPs that increased survivability.[15]

The combination of vulnerability and susceptibility survival techniques came as an afterthought for Soviet Army Aviation. The Soviets came to Afghanistan prepared for conventional warfare. As the nature of the conflict shifted to non-conventional warfare, Soviet helicopter forces were ill prepared. The evolution of survivability techniques was essential to mission accomplishment and contributed to the Soviet failure in Afghanistan. During the Soviet occupation of Afghanistan, the Army lost 329 helicopters: 127 gunships, 174 armed transports and 28 heavy lift.[16] The Soviets properly identified the existing enemy using conventional warfare but failed to identify, anticipate and adapt to a non-conventional enemy.

The United States experience in Operation IRAQI FREEDOM (2003-2008)

Unlike the Soviet invasion of Afghanistan the US assault on Iraqi forces began with a protracted air campaign. The prolonged air strikes were used as a shaping action that would set the stage for an invasion.[17] The allies flew 21,736 sorties, struck 349 Iraqi air defense targets and dropped 606 munitions from June 2001 until the beginning of the ground war on 19 March 2003.[18] The systematic destruction of the Iraqi Integrated Air Defense (IADs) set the stage for coalition air superiority. The initial US helicopter missions into Iraq came on the night of 19 March 2003. Army and Marine attack helicopters conducted Armed Interdiction missions on Iraqi border post and assault helicopters launched for troop insertions and Casevac support. Marine aviation was well prepared and trained for this type of conventional warfare.

Squadrons were well versed in low level and NOE flight profiles. Missions of close air support, escort, and assault support had been practiced and been well rehearsed. The primary

attack helicopters in use were Marine Corps AH-1W Cobras and the Army's AH-64D Apaches. Assault and medium lift helicopters were USMC CH-46 and UH-1Ns and Army UH-60s. Heavy lift helicopters were a mix of Marine CH-53Es and Army CH-47Gs.[19] US helicopters incorporated a comprehensive mix of susceptibility and vulnerability into helicopter survivability. Nearly all aircraft had an aircraft survivability suite which included radar/missile warning, chaff/flare expendables and IR jamming capabilities. All aircraft were dual-engine, armored and designed with redundant systems.

Crews flew low-level and NOE during day and night operations. The primary concern was radar guided anti-aircraft artillery (AAA), radar guided missiles, and MANPADs. In order to defeat these threats, terrain masking was used in order to prevent radar lock-on and create back-ground clutter for IR missiles. The primary concern was remnants of Iraqi conventional IADs that had not been destroyed. Delivery of weapons was done from low altitude (<500 ft AGL) with running and diving fire. Army Apaches used hovering fire for engagements. Assault support and Casevac missions were also conducted at low level. Crews were prepared for conventional combat and air defense techniques.

Shortly after moving into Iraq helicopter crews began facing heavy pockets of short range air defense in the form of RPG-7s, heavy machine guns, and small arms barrage fire. On the night of 24 March 2003, a flight of 34 AH-64Ds were tasked with intercepting and destroying elements of the Iraqi Republican Guard. The mission was aborted. All 34 of the Apaches suffered damage from small arms fire. Three were hit by RPG-7s and one force landed in a field and the aircrew and aircraft was captured.[20] Similar events were played out across the battlefield with small arms damage to helicopters operating at low level. Unlike the Soviet Army, these events did not force the US to reassess flight altitudes, but it did cause a change in

flight tactics. Army attack helicopters no longer operated in large flights and instead assumed missions of escort, close air support and armed reconnaissance.[21]

Marine helicopters experienced the same small area point air defense that the Army was facing. Several Marine helicopters were hit, but none were brought down by enemy fire early in the war. Marine successes can be contributed to the TTPs in use. Unlike Army helicopters that operated as larger maneuver elements on the battlefield, the Marines operated in smaller formations of no more than four aircraft. Marine TTPs differed greatly from the Army's TTPs. The Marines primary mission was close air support of the GCE and LCE. Occasionally flights flew in advance of friendly maneuver for armed reconnaissance. Marine assault support operated behind advancing forces and encountered similar small arms point air defense fire when conducting inserts or Casevac.

The conclusion of formal fighting was declared on 1 May 2003.[22] This marked a shift in coalition opposition forces tactics in Iraq. Similar to the Soviets in Afghanistan, US helicopters started to see the emergence of ambush tactics using DShk heavy machine guns and RPG-7s. Marine and Army units continued to fly at low level and receive battle damage and lose aircraft. The next threat that emerged was the MANPAD. Late in 2003 MANPAD launches were being reported and several helicopters were hit. These losses and the use of MANPADs in a "SAMbush" type tactic forced the Army and Marine Corps to reassess survivability.[23] Helicopters at low level were vulnerable to small arms and RPG fire. If the helicopters flew higher to avoid small arms and PRGs, they were in the heart of the MANPAD engagement envelope. This dilemma forced the services to make a swift change in helicopter survivability.

Fielded ASE hardware was effective at defeating MANPADs if they could be detected and flares dispensed. However, detecting a MANPAD launch and reacting in a timely manner was nearly impossible for the aircrews. There was no method available to detect and avoid small arms and RPG fire. The solution was to use commercial-off-the-shelf technologies to detect MANPAD launches and then queue the helicopter to dispense flares to defeat the missile. These new AAR-47(USMC)/AAR-57(USA) systems were quickly tested and approved and deployed to Iraq in 2004-2005.[24] The systems proved effective, but initially had problems with detection in certain environments. The new survivability equipment decreased susceptibility, but created strife in the conduct of flight between the USMC and the Army. TTPs would have to change to decrease susceptibility too. Since there was no way to detect small arms and RPGs the only solution was to avoid being hit by flying above effective range.[25] By flying higher, helicopters were again in the heart of the MANPAD envelope. Aircrews had to choose between the most likely threat of small arms/RPG and the most dangerous threat of MANPADs.

Like the Soviets in Afghanistan, US forces were forced to change TTPs and upgrade equipment to increase survivability and be able to function on a changing battlefield. Like the Soviets in Afghanistan, these changes also came as an afterthought. US forces anticipated a conventional battle where helicopters hovered and hunted tanks. This was not the case. Non-traditional forces adapted to US tactics and engaged low flying helicopters with small arms and RPGs. When helicopters changed their TTPs and began to fly above small arms the enemy adapted again and began using MANPADs to shoot down helicopters. More changes were made in equipment to increase survivability by decreasing susceptibility. This evolution is essential to survivability. As of 2009 the US has lost 67 helicopters to hostile fire in Iraq.[26] Both the Soviet

experience in Afghanistan and the US experience in Iraq generated an evolution in survivability that was required to maintain tactical relevance and vital to mission success.

SURVIVABILITY: CHANGE IN TACTICS OR TECHNOLOGY

The case studies from Afghanistan and Iraq demonstrate the requirement for survivability to evolve. Both vulnerability and susceptibility must be improved and incorporated into current and future helicopter design and retrofit. Survivability and mission success is affected by several factors. The roles and type of missions flown by helicopters, the amount of friendly force support, and the intensity and effectiveness of hostile air defenses define survivability requirements.[27] Helicopters can be designed to fulfill several roles. The primary roles helicopters are designed to execute are attack (AH), utility(UH), observation (OH) and cargo(CH). The MV-22 Osprey is designed to fulfill a role of CH and replace aging Marine CH-46s. Common mission helicopters are assigned combat tactical and combat support mission.[28] Friendly force support is based on air superiority.

> ***air superiority*** — *That degree of dominance in the air battle of one force over another that permits the conduct of operations by the former and its related land, maritime, and air forces at a given time and place without prohibitive interference by the opposing force. (JP 3-30)*

Having air superiority means that friendly aircraft are able to maneuver and conduct missions without any influence by the enemy that prevents the accomplishment of the MAGTF's mission.[29]

The enemy's intensity and effectiveness of hostile air defenses during the conduct of the mission can vary. The ability to predict and avoid threats during mission planning is just as essential as having the ability to detect, avoid and destroy threats as required during the conduct of the mission. In conventional warfare the enemies IADs may be easier to template, locate and

systematically destroy or avoid. In non-conventional warfare air defense threats may not reside in the form of an IADS. These threats are likely dispersed or placed in point defense of a high value item or person. However, these types of threats are not any less lethal when employed in this manner. Barrage fire of small-arms, heavy machine gun and rocket propelled grenades are common. Unguided light ($\geq$ 14.5mm) and medium ($\geq$ 23mm) AAA are also likely to be encountered. Highly mobile advanced generation III & IV MANPADs are appearing on the battlefield and challenging the concept of air superiority.[30] Additionally as more anti-air systems become readily available to non-conventional forces, it is likely to see radar guided AAA and possibly radar guided anti-aircraft missiles.

These systems can all create a kill chain that needs to be defeated in order to accomplish the mission.[31] An example: A flight of four Marine CH-53Es are conducting the first wave insert of a battalion from Naval shipping into an objective area. Marine F/A-18Cs have established local air superiority and AH-1Ws and AV-8B Harriers have cleared the area and declared the landing zones (LZs) "winter" or safe based on the Air Mission Commanders criteria. In route to the objective area, the lead CH-53E receives an indication of radar guided AAA and is subsequently engaged by medium AAA fire from a concealed position. The CH-53 aircrew suppresses the threat and AH-1Ws destroy the position with 20mm and rocket fire. A burst (3-5 rounds) of enemy AAA fire, however, hits the tail boom section of the lead CH-53E. The rounds enter the tail boom splinter and are ejected in multiple directions. The subsequent penetrations partially sever a control rod in the tail-boom.[32] The control rod breaks as the pilot attempts to maneuver for his terminal landing phase. The pilot's inability to control his tail rotor causes the aircraft to yaw uncontrollably and the helicopter falls out of control to the ground.

Two pilots, two air-crewman, and 37 combat loaded Marines are killed in the crash. Thus, mission failure.

Conversely, the AAA rounds enter the tail boom splinter and are ejected in multiple directions. The subsequent penetrations partially severe a control rod and electrical connection in the tail-boom. The pilot at the controls feels the impacts and executes evasive maneuvers. Indications in the cockpit show an impending gear box failure. The pilot elects to return to Naval shipping to preserve the aircraft/cargo and not make his insert. This results in a safety of flight mission abort and mission failure for aircrew and reduction of combat power build-up by 25% for the GCE.[33] This is just one example of mission failure due to limited survivability inherent in helicopters. How could this scenario have been avoided? Would a TTP change have prevented mission failure or is it a technological change that is required?

Knowing the location and number of the air defense systems along the route of flight is the paramount solution. By avoiding the AAA, the mission would have greater chances of success. Changes in aircraft radar signature and performance could have made the helicopter more difficult to detect and engage. Armor in the tail section would have prevented such extensive damage however, these changes likely come with other performance trade-offs (i.e. capacity, lift, speed, range, etc.). These changes are less likely with fielded out-of-production aircraft. A change in TTPs could have reduced the CH-53Es susceptibility. Keeping terrain between the AAA threat and CH-53E would have prevented detection and clear fields of fire during the AAA engagement.

The common theme for survivability for this fielded helicopter is detection of the threat system. In this example radar guided AAA caused mission failure. The threat could present in

many forms to include small arms, MANPADS, guided and unguided AAA, or radar guided missiles. Changes in TTPs can provide great successes. The combination of technological upgrades with sound TTPs will result in mission success multipliers. In the example used above, if you remove the aircraft detection variable from the equation, mission success is far more likely. Detection and location of the AAA threat could be received from off-board systems such as other aircraft, signal intelligence, and human intelligence. This would allow the aircrew to alter their route to increase survivability and the likelihood of mission accomplishment. Real time detection and identification of the threat in the cockpit would result in increased reaction-time and likelihood of mission success. Other airborne assets such as the EA-6B Prowler and E-8 Joint Surveillance and Target Attack System could easily identify and locate an emitting radar system or ground movement in the area. This information could be passed real time via data link to other assets on the battlefield to increase situational awareness and increase survivability. The required changes in survivability are not solely technology or tactics, but a combination of the two are needed in order to increase the likelihood of mission success.

ARE MARINE HELICOPTERS AND TILT-ROTORS SURVIVABLE?

The methods, standards and assessment metrics of Marine aviation training have a direct correlation to helicopter survivability. Aircrews are first introduced to the concept of survivability when they enter their permanent squadrons. Prior to this they have been in the Replacement Air Group (RAG) or Fleet Replacement Squadron (FRS) learning to fly their platform with very little consideration for survivability. Upon introduction to the "fleet" crews continue to develop flying skills and fighting skills are introduced and honed. For attack and utility pilots, basic conventional weapons delivery (BCWD), NOE and low-level flying, tactical

formation and different mission types are introduced. For assault pilots, tactical formation, navigation, and mission types are the focus as well.

Relatively little time is spent on the integration and use of ASE. In the AH-1W current T&R there are only two out seventy six applicable sorties that focus on use of the ASE gear and integration of the systems into mission planning and flight profiles.[34] In the CH-46 and CH-53 the numbers are similar.[35] The new MV-22 has been praised as an evolution in survivability, but has only five dedicated training sorties to survivability.[36] The training for helicopter and tilt-rotor crew is very focused on how to fly and fight the aircraft. The emphasis on education and training to be survivable is lacking. There is no assessment or measure of success external to the squadron.[37] A reasonable level of mission accomplishment cannot be achieved with a primary focus on flight skills, navigation or weapons delivery alone. These skills contribute to mission accomplishment, but in order to fight the aircraft aircrew must be able to survive. There will be no troops in the zone or rockets on target if aircraft fail on ingress to or egress from the objective area.

In addition to training, aircraft configuration and design must be considered. The goal of designing the right amount of combat survivability into a military aircraft is a challenging one. Survivability must be considered in the initial design of the helicopter as well as in the operation and sustainment of these airframes. The Marine Corps' newest addition to the assault support inventory, the MV-22 Osprey, was designed to fly higher and faster in order to avoid normal threats to assault support helicopters. The increase in altitude however, put the Osprey in a new threat environment of medium-to-high altitude radar guided missiles. Additionally, the Osprey still has to make the same approach as the CH-46E did to a landing zone, where the threat is the highest. While hailed as an evolution in survivability, the Osprey traded one threat regime for

another and maintained the same survivability equipment as the rest of the aging Marine Corps Assault Support fleet. [38] Therefore, providing zero net gain in survivability.

Vulnerability upgrades in helicopter design are hard to alter once the aircraft is no longer in production. A back-up hydraulic system or the addition of another engine is a change a not likely to occur. The incorporation of light weight armor, self-sealing fuel tanks or effective expendables (flares/chaff) is more likely. Susceptibility upgrades are the fastest and easiest means to make changes in aircraft combat survivability, but these changes come with trade-offs. Increase the amount of expendables an aircraft can carry and consequently increase survivability. The trade-off is a decrease in external (weapons) or internal (troops/cargo) load capacity. The primary application of these changes is a combination of survivability hardware/software equipment, self-defense systems and TTPs to maintain capability and increase mission success.

Equipment upgrades in the form of software and hardware changes are essential for out-of-production aircraft. Initial survivability design can be sound at production, however when the production life-cycle of an airframe is twelve years and the planned operational life is twenty years, initial survivability systems are often limited in application or quickly become outdated.[39] The current life of software in most systems today is less than one year.[40] Hardware has a longer life span, but it too quickly becomes outdated. Aircraft survivability equipment must be open architecture and easily adaptable to a changing combat environment. The equipment must be networked to provide aircrew situational awareness across the battlefield and easily upgraded to keep up with evolving weapons systems and enemy TTPs.

The incorporation of new TTPs with upgraded equipment will further enhance combat survivability and increase the prospect of mission success, but are not stand alone solutions to a

threat system or scenario. In combination with all the external and internal assets on the battlefield TTPs can be effective. Assume that the CH-53E flight described in the scenario is not configured with any type of radar detection equipment or is equipped with an antiquated system. The crew has no means to detect the radar guided AAA unless it fires at them or another aircraft. If the AAA fires at another aircraft, that aircrew is responsible to pass a voice report of location and type of threat via radio. This can take time to pass and get disseminated throughout the command and control systems due to line of sight and communications limitations. The CH-53E crew may be in the engagement zone of the AAA before there are any warnings. The appropriate TTP for AAA fire is real time and is the aircrews' only means to counter the AAA. Conversely, a CH-53E that is networked into a threat detection system that plots enemy air-defense as soon as it is detected and is equipped with sensors to detect and identify a AAA radar searching for a target is far more survivable and increases the probability of mission success.

The limited survivability of helicopters and tilt-rotors will have and are currently having significant impacts on maneuver warfare concepts. In Afghanistan a non-conventional force using limited air defense assets destroyed 329 helicopters in the span of nine years. In Iraq 67 helicopter were lost over a period of six years to a similar non-conventional force. Air superiority is a requirement for successful maneuver operations, but it may not always be achievable. Anti-shipping and anti-air defenses are going to be formidable for any type of forcible entry scenario. Ship to shore movement and freedom of aviation maneuver in the battle-space are requirements for a dynamic and timely campaign. Combat survivability for helicopters is essential for mission success on today's and tomorrow's battlefields.

AN ANSWER

In the 21st Century the Marine Corps cannot expect to plan and equip for every scenario. Not only is this operationally unrealistic, but it is also fiscally impractical. *The Marine Corps Vision and Strategy 2025* document defines the direction of the Marine Corps for the next fifteen years. The document is intended to inform all Marines where the Corps is headed, give combatant commanders a concept of how to best be employed, and to provide civilian leadership a reference point as to how the Marine Corps plans to contribute to national defense in the coming years and decades.[41] In order to be a "multi-capable, highly responsive, versatile and innovative" force the evolution of training, equipping and fighting must be revolutionary and far reaching.[42] It is essential to cultivate innovative training and tangible assessment, to put emphasis on technical development and employment and ensure assault support elements are deployed and employed appropriately in the Air Combat Element of the MAGTF.

Whether on a conventional or non-conventional battlefield, there will always be threats that cannot be detected, defeated or defended against at every encounter. The enemy has a will and the ability to evolve as well. Assault assets must have the ability to survive in order to accomplish the mission. Cobras, armed with the most advanced laser guided precision anti-tank and anti-personnel weapons for close air support, are ineffectual if they cannot get to the fight and remain on station to employ their weapons. Ospreys and Super Stallions that have extended ranges and substantial cargo capability are useless if they cannot deliver their troops, equipment or logistical support to the GCE. These issues cannot be an after-thought. The resolution must be palpable and judicious.

Training is the first key element in order to comprehend the importance of survivability. Aircrew training needs to be mission oriented in that it "provides Marines with the skills, knowledge, and attitudes necessary to execute combat-related missions."[43] Additionally, training standards must be readily defined and attainable. The Aviation Training and Readiness (T&R) Manuals are reviewed and revised by fleet representation and Marine Aviation Weapons and Tactics Squadron One (MAWTS-1) and published per the directives and approval of the Aviation Training Division of Headquarters Marine Corps. Current training requirements are inadequate. The success of the assault support mission is heavily dependent on survivability.

Fleet Marine force operators and leadership need to recognize this inadequacy and correct the problem. Survivability training needs to be incorporated into all levels of individual and collective training. Training standards and assessment metrics need to be incorporated into the Mission Essential Task(METs) for every assault support aircraft. Major Shawn "Depot" Hoewing, the Assault Support Survivability Subject Matter Expect at MAWTS-1 advocates the incorporation of threat planning, reaction and debriefing into every mission-oriented training flight. "It is not enough to focus on just one type of threat or scenario. The current and future operating environment is dynamic and unforgiving. Aircrew must be prepared to fight to survive and retire in order to fly another day."[44] The T&R manuals need to reflect the appropriate amount of individual and collective training events in the training syllabus. Additionally, the training metrics need to be clearly defined and assessable in aviation METs. Therefore ensuring feedback can be given in order to update TTPs or equipment.

The evolution in training requirements and metrics will have a corresponding impact on the effective development of TTPs used to enhance survivability. Just as the Soviets and US forces evolved their TTPs in respective conflicts the goal should be to develop and validate TTPs

in a training environment using battle drills and simulation. Ranges and training events such as the Weapons and Tactics Classes in Yuma, Arizona and Enhanced Mohave Viper pre-deployment assessment exercise in 29 Palms, California can be the test grounds to validate survivability. Just as crews are assessed on their ability to reach the correct LZ on time or hit within the effective blast radius of a rocket, crews will be assessed on pre-flight threat planning, reaction, and survivability tactics during the execution of the mission. [45] This exposure to survivability concepts in planning and action will decrease the time required and the number of aircraft and lives lost in combat to make effective adjustments to TTPs.

Complementary to training is having the proper equipment installed in order to interrupt or avoid any type of air defense sequence. In the CH-53 scenario, a crew that had been properly trained and well exposed to simulated threat scenarios would have still been reactionary against the AAA threat. Their training and exposure would have increased the likelihood of survivability, but only to a limited degree. The ability to be able to detect or receive off-board information on the AAA threat would have provided a greater measure of survivability and mission success.

In Afghanistan today we face a similar scenario as the Soviets and US forces in Iraq did in previous engagements. Emerging threats are driving our TTPs. In Iraq in 2003 USMC helicopters had limited to no ability to automatically detect MANPAD launches. The primary defense was maneuver and manual dispense of expendables.[46] As more Army and Marine helicopters were lost to MANPADs, sensors and expendables were upgraded.[47] The modifications took time, but eventually all aircraft in Iraq were equipped with upgraded survivability suites that included exhaust suppression, automatic detection and dispense of improved expendables. In Afghanistan, the primary threat to helicopters has been machine gun

and small arms fire. Similar to Iraq the solution is a reactionary answer: retrofit hardware and software upgrade to detect machine gun and small arms fire. In order to meet the Commandant's guidance in *Vision and Strategy 2025*, the Marine Corps cannot continue to equip its assault support aircraft in a reactionary manner.

The survivability solution must be a forward looking and farsighted solution. While the current conflicts have driven Marine Corps assault support aviation to adapt new equipment to increase survivability against MANPADs and small arms fire, advancements in radar survivability have been stagnant. LtCol Davis J. "Atlas" Dowling, from the Advanced Tactical Aircraft Protection Systems Program Office (PMA-272), Assault Support branch, emphasizes the importance of not becoming reactionary in the field of helicopter survivability. "We have found solutions for threats we have encountered, but it has cost us in lives and airframes."[48] The current conflict has tied us to certain types of threats. A new conflict with a more capable enemy could present a survivability dilemma. The time that it takes to react to and equip assault support helicopters to a robust IADs system, even with local air superiority, could mean the difference in lives lost and even the balance of victory or defeat.[49]

Threats on the battlefield need to be detected and avoided or destroyed preemptively. Onboard equipment would be required to allow the crews to react real-time to undetected threats and survive. These systems would integrate small-arms, rocket propelled grenades (RPGs), IR (MANPADS) and radar threat detection and identification into a single system. En route the CH-53 flight encounters radar guided AAA. Survivability equipment would report warning information, relative bearing, and most likely the type of system. The flight lead would be able to call out the appropriate flight maneuver, use of chaff or flares as required and direct accurate fire onto the AAA position. This reactionary mode of susceptibility would be the less likely and

a last resort for survivability. Networked information would decrease reactionary survivability and increase the likelihood of mission accomplishment. The Marine Corps must incorporate these technologies into future helicopter design and integration in order to compliment current assault support doctrine. The emphasis on these technologies and the integration into helicopter survivability is essential for future mission success.

How the Marine Corps fights its ACE requires that survivability be a priority. In order for the ACE to provide significant firepower and mobility to the MAGTF, the ACE must be able to operate on any battlefield.[50] Col Thomas "Wheels" Weidley, the commander of Marine Aircraft Group 39 in Camp Pendleton, California, conveys his confidence in the ability of the ACE to do just that. His opinion is that the current T&R Manuals as well as equipment allow the ACE to be a force multiplier for the GCE on a conventional and non-conventional battlefield. Survivability for the ACE is a requirement for GCE mission accomplishment. The ACEs' ability to provide combat assault support has not diminished.[51]

The reliance on the ACE to provide tactical, logistical or administrative support to the MAGTF can be the difference between mission success and failure.[52] Colonel Julian Alford, Commanding Officer of the Basic School and a prior Battalion Commander, is fervent in his stance on the importance of assault support to the GCE. The ability to exploit opportunity, maintain tempo and provide flexibility is essential to any commander in the conventional and non-conventional fight. Colonel Alfords' concerns with fighting the ACE lie in the organization of current ACE assets.[53] Combat assault support requires helicopters that can get into and out of austere landing zones in a timely and efficient manner. The MV-22 has limitations due to size and capability while the improved UH-1Y has proven itself invaluable as a light assault support platform.[54] How the ACE fights is doctrinally sound. The application of survivability to assault

support doctrine is required and must continue to progress and adapt. The ACE must also continue to evolve in order to meet future challenges and also be willing to reevaluate its organizational predispositions to remain relevant on today's battlefield.

CONCLUSION

The Marine Corps must continue to adapt as it has done for 235 years. As operations wind down in Iraq and continue to increase in Afghanistan the Marine Corps needs to assess its ability to successfully conduct assault support operations. We must manage expectations of our abilities or accept the higher risk and political implications of loss of aircraft and lives.

Changes in training and upgraded equipment are required to ensure the ACE continues to contribute to mission accomplishment. These changes are essential if the ACE is to continue its celebrated relationship with the GCE. Future concepts such as Sea Basing, Operational Maneuver from the Sea, and Ship to Objective Maneuver rely heavily on USMC assault support missions.[55] These concepts of operational maneuver and vertical assault have limited applicability if helicopters are unable to operate due to the threat environment. Survivability in the ACE must be weighted the same as navigation, communication and weapons delivery.

> *"Today [aviation] is the dominant factor in war. It may not win a war by itself alone, but without it no major war can be won."* [56]
>
> Adm Arthur Radford

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[2] Ball, Robert E., 1-2.

[3] Ball, Robert E., 2.

[4] Ball, Robert E., 2.

[5] The Irregular Warfare Joint Operating Concept (IW JOC), Version 1.0, dated 11 September 2007, B-8.

[6] Joint Publication (JP) 1-02, *Department of Defense Dictionary of Military and Associated Terms*, or FM 1-02, *Operational Terms and Graphics*

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[9] Grau, Lester W., Gress Michael A., 12-13.

[10] Grau, Lester W., Gress Michael A., 213.

[11] Grau, Lester W., Gress Michael A., 210.

[12] Everett-Heath, John. *Soviet Helicopters: Design, Development and Tactics.* Coulsdon: Jane's Information Group, 1988, 189-190.

[13] Grau, Lester W., Gress Michael A., 212.

[14] Grau, Lester W., Gress Michael A., 213.

[15] Everett-Heath, 190.

[16] Grau, Lester W., Gress Michael A., 221.

[17] Cordesman, Anthony H.. *The Iraq War: Strategy, Tactics, and Military Lessons.* Westport, Conn.: Praeger, 2003, 253-254.

[18] Cordesman, Anthony H., 253.

[19] Cordesman, Anthony H., 208.

[20] Cordesman, Anthony H., 254, 318-319.

[21] Cordesman, Anthony H., 321-322.

[22] Cordesman, Anthony H., 517.

[23] SAM-bush as used in todays' military terms refers to ambushes using MANPADs or radar guided missile for a point defense and waiting until aircraft is well within the engagement zone before firing multiple times. Term first used in Kosovo to describe Serbian tactics against US A-10s.

[24] LtCol Dowling, PMA-272 email, phone personal correspondence June 2008-Mar 2011.

[25] Interviews & correspondence with MAG-39 CO Col Weidley(24 Feb 2011), Discussion and correspondence with MAWTS-1 Instructors and OIF veterans Major John "Stryker" Bidstrup, Major Jeremie "Hank" Hester, Major Jay "UTAH" Moorman (June 2008-Mar 2011).

[26] Maduka, Victor Maj, *Considerations for Employment of Marine Helicopters in Future Conflicts:How Much Risk is Acceptable?* USMC Command and Staff Thesis, AY 07-08

[27] Ball, Robert E., 234.

[28] Ball, Robert E., 233.

[29] *MCWP 3-22.2 Suppression of Enemy Air Defenses (SEAD).* Washington, DC: Headquarters, U.S. Marine Corps, 2001, 1-1.

[30] Interview/Discussions Majors Hoewing, Hester, Moorman, Bidstrup.

[31] Ball, Robert E., 10-11. Kill Chain – 1.Search 2.Detect 3.Engage 4.Intercept 5.Hit 6.Damage

[32] Ball, Robert E., 36-40. Summary of Vulnerability & Susceptibility events and reduction.

[33] Ball, Robert E 282-28. Summary created to demonstrate point based on Dr. Balls analysis of a similar event.

[34] *Marine Corps Order 3500.48A,* AVIATION TRAINING AND READINESS (T&R) MANUAL, AH-1W, Washington, DC: Headquarters, U.S. Marine Corps, Dec 2004.

[35] *Marine Corps Order 3500.89,* AVIATION TRAINING AND READINESS (T&R) MANUAL, CH-53, Washington, DC: Headquarters, U.S. Marine Corps, Jan 2006. and *Marine Corps Order 3500.88,* AVIATION TRAINING AND READINESS (T&R) MANUAL, CH-46, Washington, DC: Headquarters, U.S. Marine Corps, Jan 2006.

[36] *Marine Corps Order 3500.11,* AVIATION TRAINING AND READINESS (T&R) MANUAL, MV-22, Washington, DC: Headquarters, U.S. Marine Corps, Feb 2007.

[37] Lack of MCRE standards and assessment processes. MAWTS-1 interview w/ Majors Bidstrup and Hester.

[38] MV-22 NATOPS. Interview & emails w/ Maj "Virus" Bennett MAWTS-1 MV-22 department head.

[39] Acquisition timeline of MV-22 as well as AH-1Z & UH-1Y. Data from acquisition timeline discussions with LtCol Dowling.

[40] Interview with LtCol Dowling PMA-272 Aircraft Survivability Branch USMC (Nov-Jan 2010/11.

[41] *Marine Corps Vision & Strategy 2025,* Washington, DC: Headquarters, U.S. Marine Corps, 2010, 6.

[42] *Marine Corps Vision & Strategy 2025,* Washington, DC: Headquarters, U.S. Marine Corps, 2010, 8.

[43] *MCWP 3-0B How to conduct Training.* Washington, DC: Headquarters, U.S. Marine Corps, 1996, 1-5.

[44] Summary of phone Interview w/ Maj Hoewing and follow on email correspondence (June 2008- March 2011).

[45] EMV assessment metrics from MAWTS-1 Maj Bidstrup, Maj Hester.
[46] Cordesman, Anthony H., 330.

[47] LtCol Dowling interview.

[48] LtCol Dowling interview.

[49] LtCol Dowling interview summary of comments.

[50] *MCWP 3-24 Assault Support.* Washington, DC: Headquarters, U.S. Marine Corps, 2004, 1-1 & 1-3.

[51] Interview Colonel Weidley (24 Feburary 2011)

[52] Interview Colonel Weidley (24 Feburary 2011)

[53] Interview Colonel J. Alford (23 Feb 2011)

[54] Discussion Maj Bennett and Major Greg "Squib" Rivaldi, HMLA-169 OPSO.

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[56] *MCWP 3-2 Aviation Operations,* 1-1.

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Interview with Major Jay "UTAH" Moorman, Marine Aviation Weapons and Tactics Squadron One, Prior Assault Support Department Head

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